UDC 551.515.2;551.513.3(261.1) "1968"

ON THE CAUSES OF THE SMALL NUMBER OF ATLANTIC HURRICANES IN 1968 [1]

JEROME NAMIAS

Extended Forecast Division, Weather Bureau, ESSA, Washington, D.C.

1. INTRODUCTION

The year 1968 had an unusually inactive hurricane season. Up to November there were only four storms that reached hurricane strength. On the other hand, according to Dr. Robert Simpson, Director of the National Hurricane Center (verbal communication), there were an unusually large number of easterly waves.[2] These abortive conditions for hurricane formation, especially following the landfall of a tropical storm in Florida as early as June, pose an intriguing problem. It is the purpose of this note to throw some light on this problem in order to provide further guidance for early estimates of the frequency of hurricanes in a given year. Such studies could contribute to the elusive physical solution of hurricane formation.

2. THE LARGE-SCALE QUASI-STATIONARY METEOROLOGICAL SITUATION

The mean atmospheric circulation at sea level and its departure from normal for the summer of 1968 (fig. 1) show abnormally low pressure at the surface in the western Atlantic with the greatest negative anomaly off Newfoundland. This represents the cumulative effect of many cyclones that moved out from eastern Canada, rapidly intensified, and frequently stalled. This negative anomaly developed as early as May, as shown in table 1. The standardized departures (ratio of departure from normal to standard deviation) show especially large values in

[1] Part of this work was performed at the Scripps Institution of Oceanography, where the author from time to time is a visiting scientist.

[2] Dr. Simpson has recently documented this statement in Simpson et al. (1969).

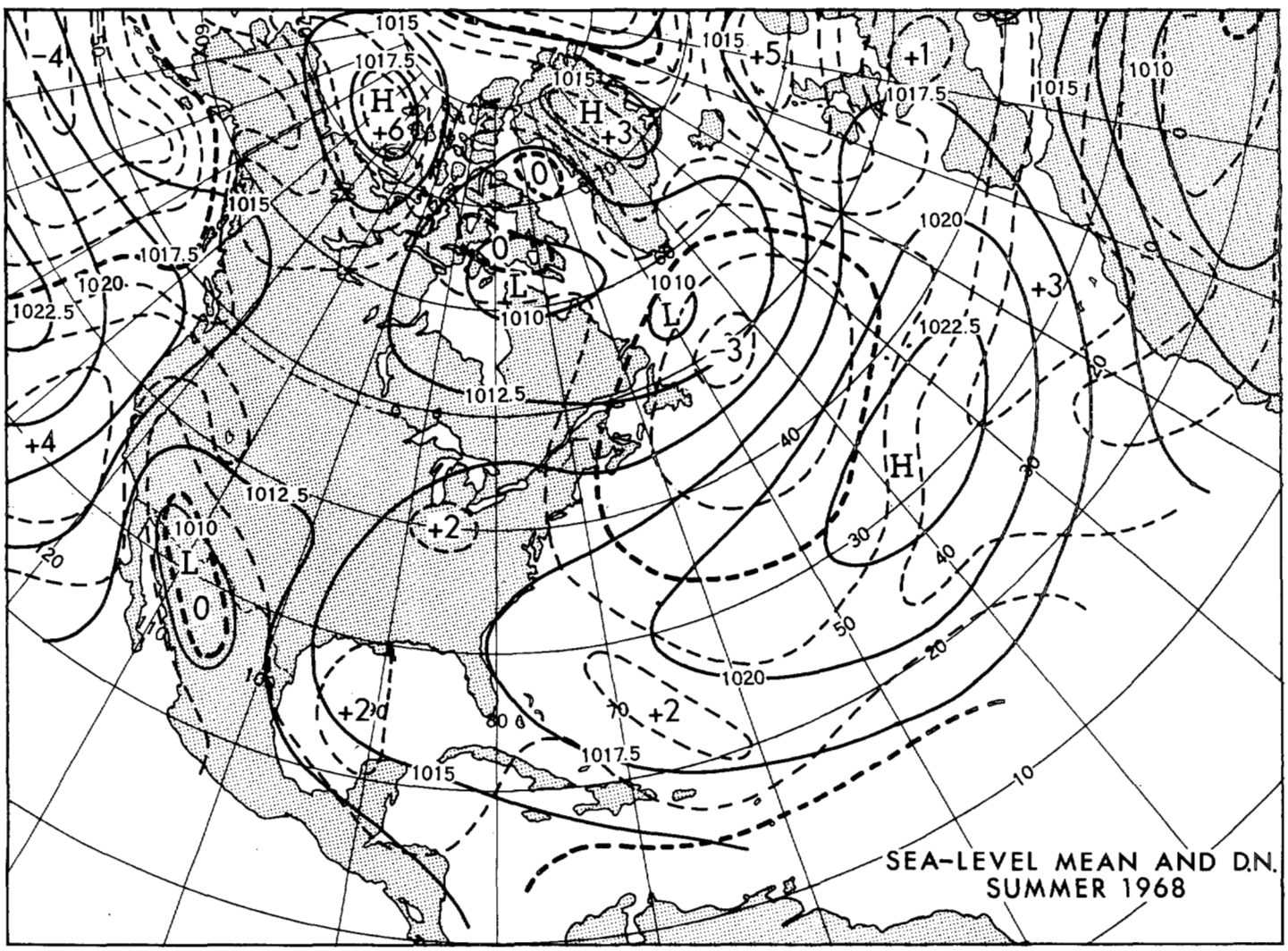

FIGURE 1.—Mean sea level pressure and departures from normal (D.N.) in millibars for the summer (June, July, August) of 1968.

TABLE 1.—*Sea-level pressure departures from normal at 45° N., 45° W.*

	Departure (mb)	Standardized departure
April	+4	1.0
May	−4	−1.2
June	−2	−0.7
July	−1	−0.4
August	−4	−2.0
September	+1	0.3
October	−7	−2.1

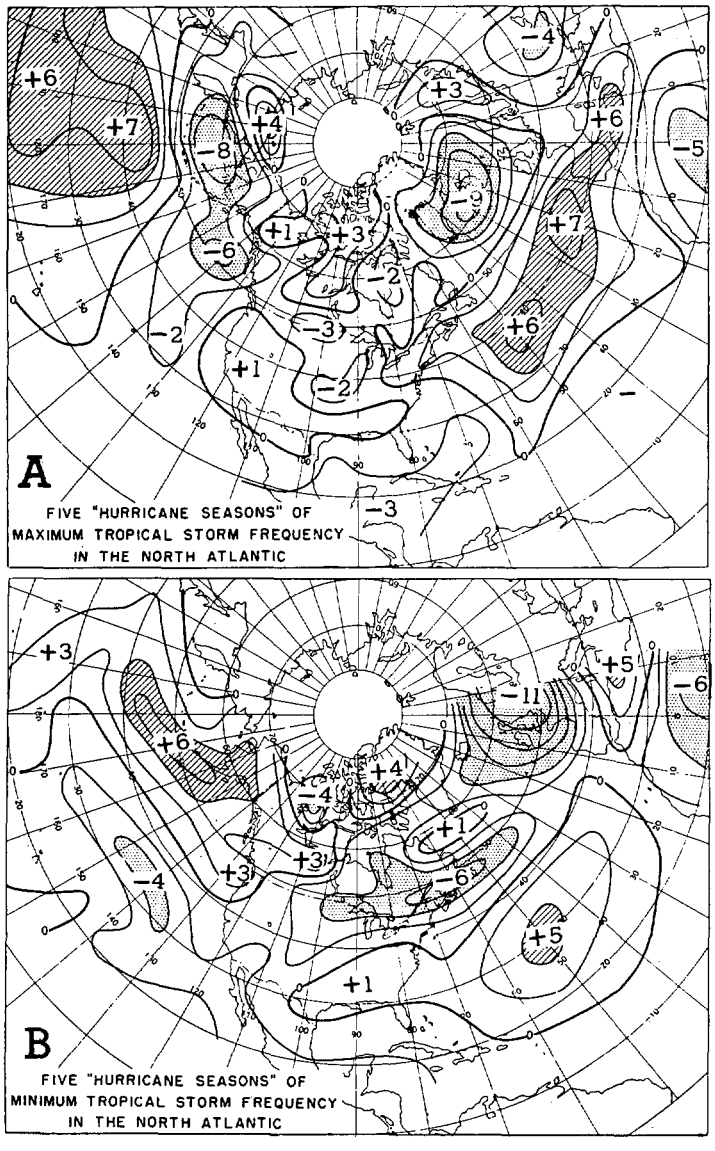

FIGURE 2.—Average 700-mb height anomalies for the five seasons of maximum tropical cyclone formation for the entire Atlantic region (A) and for the five seasons of minimum formation (B) for the period 1933–55 (after Ballenzweig, 1956).

August and October, months during which western Atlantic and Caribbean hurricanes, respectively, frequently develop. However, in August 1968, only one hurricane formed and in October one. In September the center of the negative anomaly (−5 mb) was observed at 37.5° N. and 52.5° N., and there were two tropical storms, neither of which reached hurricane intensity.

It is well known that the positions and intensities of the semipermanent centers of action usually reflect the conditions favorable or unfavorable for hurricane formation and movement (Namias, 1955; Ballenzweig, 1956). The composite 700-mb height anomalies for five "hurricane seasons" (August, September, and October) of maximum and five seasons of minimum formation given by Ballenzweig (1956) are reproduced in figure 2. Logically, seasons rich in hurricanes are generally associated with northerly displacements of the Atlantic centers of action (Icelandic Low and Atlantic High) while more southward displacement is associated with diminished hurricane activity. Note especially the negative anomaly around Newfoundland in the latter case and the greater resemblance of the summer of 1968 to this chart.

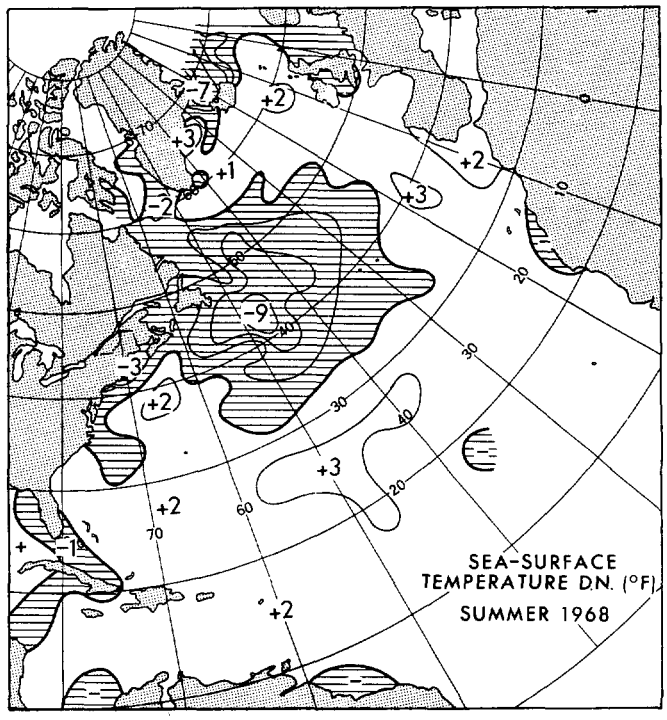

FIGURE 3.—Sea-surface temperature departures from normal (D.N.) in °F for the summer of 1968.

The physical explanation of the differing incidence may be related to the relative depth of the subtropical easterlies, which in turn is related to the development of overlying westerlies associated with the subpolar Low. Perhaps the prevailing vertical wind shear in the formation region as discussed by Gray (1968) plays an important role. In this brief paper it is not intended to delve into the details of the flow and meteorological characteristics in the formation areas, but rather to suggest clues for the persistence of the abnormal pressure distribution over the western Atlantic.[3]

Coincident with the abnormally low pressure, abnormally cold surface water temperatures were observed in the western Atlantic during the entire summer and fall of 1968. The mean departures from normal for the entire summer are shown in figure 3 where the sea-surface temperatures averaged 8.5°F below normal in the center of the cold pool. This cold water extended down to at least 100 m at Ships D and E, according to unpublished

[3] The statements in this paragraph are shown to be valid in the thorough treatment by Simpson, Frank, Shideler, and Johnson (1969) and by Sugg and Herbert (1969). The present author had access to these articles after this paper was written.

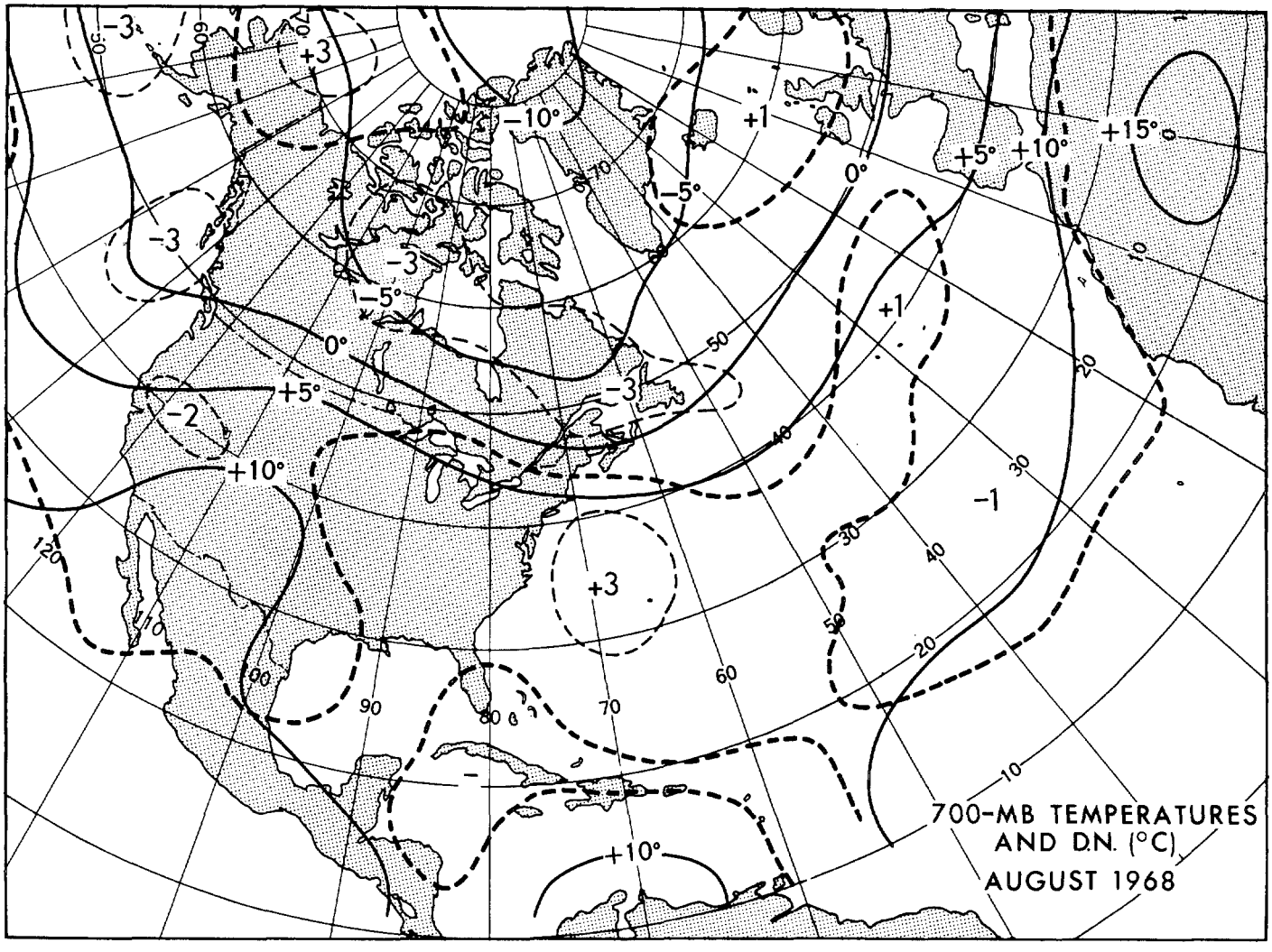

FIGURE 4.—Isotherms at 700 mb and departures from normal (D.N.) in °C for August 1968.

British reports, which cited that in August this water as it was as cold normally is near the winter minimum.

The cold pool of water is linked to the greater than normal cyclonic activity already described, because in summer increased cloudiness (diminished insolation), increased wind, and enhanced upwelling favor cool water temperatures; but it is also possible that the cold pool of water, situated near the western Atlantic, could displace the westerlies farther south than normal by influencing the position of the thermal trough in the midtroposphere. Indeed, figure 4 shows a displacement of the 700-mb thermal trough east of its normal position and over the cold water pool. Whenever this thermal upper air pattern developed, cyclones emerging from Labrador could be forced southward (or less northward than normal). In this manner a quasi-stationary forced long-wave trough might develop in the western Atlantic and thus be unfavorable to hurricane development farther south.

It is also noteworthy that the Newfoundland negative pressure anomaly, particularly in the midtroposphere (map not reproduced) was in an area where positive anomalies are usually found with the upstream circulation as it was observed over the Hudson Bay and over Alaska. This statement is based on studies of "teleconnections" made by O'Connor (1969). This "nonmodal" character of the general circulation during the summer of 1968 lends further support to the generation by air-sea interactions of a forced trough off Newfoundland.

REFERENCES

Ballenzweig, E. M., "Seasonal Variations in the Frequency of North Atlantic Tropical Cyclones Related to the General Circulation," *Proceedings of the Tropical Cyclone Symposium, Brisbane, December 10–14, 1956*, Director of Meteorology, Melbourne, Dec. **1956**, pp. 57–70.

Gray, W. M., "Global View of the Origin of Tropical Disturbances and Storms," *Monthly Weather Review*, Vol. 96, No. 10, Oct. **1968**, pp. 669–700.

Namias, J., "Long Range Factors Affecting the Genesis and Paths of Tropical Cyclones," *Proceedings of the UNESCO Symposium on Typhoons, Tokyo, November 9–12, 1954*, The Japanese National Commission for UNESCO with the Cooperation of the Organizing Committee for the UNESCO Symposium on Typhoons, **1955**, pp. 213–219.

O'Connor, J.F., "Hemispheric Teleconnection of Mean Circulation Anomalies at 700 Mb," *ESSA Technical Report* WB 10, U.S. Department of Commerce, Washington, D.C., **1969**, (to be published).

Simpson, R. H., Frank, N., Shideler, D., and Johnson, H. M., "Atlantic Tropical Disturbances of 1968," *Monthly Weather Review*, Vol. 97, No. 3, Mar. **1969**, pp. 240–255.

Sugg, A. L., and Hebert, P. J., "The Atlantic Hurricane Season of 1968," *Monthly Weather Review*, Vol. 97, No. 3, Mar. **1969**, pp. 225–239.

[*Received January 16, 1969; revised February 4, 1969*]